Solving Motion Problems using Kinematic Equations – Part Deux.

#1 ⊕ FWD →

Tom Burke

$\vec{v}_1 = 0$ m/s
$\Delta\vec{d} = 100$ m
$\Delta t = 12$ s
$\vec{a} = ?$
~~$\vec{v}_2$~~

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}\Delta t^2$
$100 = 0 + \frac{1}{2}\vec{a}(12)^2$
$\vec{a} = 1.39\ m/s^2$

Asafa Powell

$\vec{v}_1 = 0$ m/s
$\Delta\vec{d} = 100$ m
$\Delta t = 9.74$ s
$\vec{a} = ?$
~~$\vec{v}_2$~~

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}\Delta t^2$
$100 = 0 + \frac{1}{2}\vec{a}(9.74)^2$
$\vec{a} = 2.11\ m/s^2$

#2 ⊕ →

$\Delta t = 0.08$ s
$\vec{v}_2 = 0$ m/s
$\vec{a} = ?$
$\vec{v}_1 = 13$ m/s
~~$\Delta\vec{d}$~~

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$
$0 = 13 + \vec{a}(0.08)$
$\vec{a} = -162.5\ m/s^2$

#3 $\Delta\vec{d} = ?$ ⊕ FWD →

$\vec{v}_1 = 15$ m/s
$\vec{v}_2 = 10$ m/s
$\Delta t = 8.0$ s
~~$\vec{a}$~~

$\Delta\vec{d} = \frac{(\vec{v}_1 + \vec{v}_2)}{2}\Delta t$
$= \frac{(15+10)}{2}(8)$
$= 100$ m

#4 ⊕ →

$\vec{v}_1 = ?$
$\Delta\vec{d} = 120$ m
$\Delta t = 5.60$ s
$\vec{v}_2 = 15$ m/s
~~$\vec{a}$~~

$\Delta\vec{d} = \frac{(\vec{v}_1 + \vec{v}_2)}{2}\Delta t$
$120 = \frac{(\vec{v}_1 + 15)}{2}(5.60)$
$240 = 5.60\vec{v}_1 + 84$
$\vec{v}_1 = 27.8\ m/s$

#5

$R = 6400\,km = 6400000\,m$

$\Delta d = 2\pi R = 2\pi(6400000)\,m$ ← circumference of earth

$\Delta t = 80\,days = 1920\,h = 6912000\,s.$

$v_{avg} = \frac{\Delta d}{\Delta t} = \frac{2\pi(6400000)}{6912000}$

$= 5.8\,m/s$

$= 20.9\,km/h$ (×3.6)

#6 $\vec{v}_1 = 40\,km/h$ (÷3.6 → 11.11 m/s)

$\vec{a} = 2.3\,m/s^2$

$\Delta t = 2.7\,s.$

$\Delta \vec{d} = ?$

⊕ →

$\Delta \vec{d} = \vec{v}_1 \Delta t + \frac{1}{2}\vec{a}\Delta t^2$

$= 11.11(2.7) + \frac{1}{2}(2.3)(2.7)^2$

$= 38.4\,m$

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$

$= 11.11 + 2.3(2.7)$

$= 17.3\,m/s$

#7 ⊕ →

$\vec{a} = -5.55\,m/s^2$

$\Delta \vec{d} = ?$

$\vec{v}_1 = 50\,km/h$ (÷3.6 → 13.89 m/s)

$\vec{v}_2 = 5\,m/s$

$\vec{v}_2^{\,2} = \vec{v}_1^{\,2} + 2\vec{a}\Delta \vec{d}$

$5^2 = 13.89^2 + 2(-5.55)\Delta \vec{d}$

$\Delta \vec{d} = 15.1\,m$

#8 ⊕→

(a) $\vec{v}_1 = 0 m/s$

$\Delta\vec{d} = 450m$

$\vec{a} = 14 m/s^2$

$\vec{v}_2 = ?$

~~Δt~~

$\vec{v}_2^{\,2} = \vec{v}_1^{\,2} + 2\vec{a}\Delta\vec{d}$

$= 0 + 2(14)(450)$

$\vec{v}_2 = 112.2 m/s$

(b) $\vec{a} = -7.0 m/s^2$

$\Delta\vec{d} = ?$

$\vec{v}_1 = 112.2 m/s$ (from part a)

$\vec{v}_2 = 0 m/s$

~~Δt~~

$\vec{v}_2^{\,2} = \vec{v}_1^{\,2} + 2\vec{a}\Delta\vec{d}$

$0 = 112.2^2 + 2(-7.0)\Delta\vec{d}$

$\Delta\vec{d} = 900m$

while parachute is deployed.

$\Delta\vec{d} = 1350m$ total if you include $\Delta\vec{d}$ from part (a).

#9 $\Delta\vec{d} = 100m$ ⊕→

$\Delta t = 9.84 s$

$\vec{v}_{avg} = ?$

$\vec{v}_{avg} = \frac{\text{total displacement}}{\text{total time}}$

$= \frac{100}{9.84} = 10.2 m/s$

#10 $\Delta t = 0.5 s$ ⊕→

$\vec{v} = 120 km/h$

$= 33.3 m/s$

$\Delta\vec{d} = ?$

assuming uniform motion

$\Delta\vec{d} = \vec{v}\Delta t$

$= 16.67m$